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CARE AND REPAIR OF FARM IMPLEMENTS

No. 4

MOWERS, REAPERS, AND BINDERS

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THIS bulletin, dealing with the care and repair of mowers, reapers, and binders, is one of a series to be issued by the Department of Agriculture. Others of the series will deal with the care and repair of plows and harrows, farm shop and equipment, farm shop practice, and other farm implements.

Thoughtlessness in the handling, care, and repair of farm machinery results annually in the loss of many thousands of dollars and much time to the farmer. At this time every minute should be made productive of some result and every dollar should be saved.

This series is published to aid the farmer in preparing his machinery for the season's work at a period when he has time to do so and to minimize delays and loss of time in the field.

CARE AND REPAIR OF FARM IMPLEMENTS.

No. 4. MOWERS, REAPERS, AND BINDERS.

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NEED OF ATTENTION TO IMPLEMENTS.

UNDOUBTEDLY many mowing machines have been or are about to be scrapped though still capable of doing several years of useful work if only a small percentage of their original cost were expended upon them for repairs. The proper time for overhauling these machines is during their period of inactivity and before the rush of spring work. If put off until needed, delay incident to getting repair parts promptly, press of other work, and the hazy recollection of the past season's difficulties with that machine may hinder the efficient prosecution of this work.

At the end of the season's work with any machine it is a plan well worth while to make out a schedule of needed repairs and adjustments for that particular machine and file it in a convenient place, so when opportunity arises the work may be taken up and prosecuted expeditiously. The machine itself represents capital invested. It should be housed properly and not left in a fence corner or other out of the way place for wooden parts to rot and metal parts to rust, which, even for short periods, may cause more deterioration than the season's use.

When putting away, see that the knife bar is left clean and wiped with a greasy rag and stored in a dry place. Also place a block of wood or other support under the mid point of the tongue so that it will not acquire a permanent sag. If stored with the cutter bar in a vertical position, place a block of wood under the shoe to take the

weight off the frame. All accumulations of macerated vegetable matter, dirt, and grease should be removed, and the bright parts oiled or greased.

REPAIR OF MOWERS.

Preparatory to overhauling, remove the machine to a vacant place on the shed floor where the light is good and the machine is readily accessible on all sides, or, if the weather is not inclement, to a shady place in the yard where the ground is fairly level. Have some definite system in going over the machine. The following is suggested:

Alignment of cutter bar.—With the tongue blocked up in normal position of use and lifting spring adjusted so that the inside shoe is just floating, test for alignment by stretching a string from the center of the pitman bearing through the center of the knife-head bearing to the outer end of the cutter bar. When properly aligned the outside end of the knife bar will lead the string by about 1 inch for a 5-foot cutter bar and about $1\frac{1}{2}$ inches to $1\frac{1}{4}$ inches for a 6-foot bar. The drag on the cutter bar when in use will cause it to drop back to a normal position.

Types of aligning devices differ with different makes of mowers. A common type is an adjustable rod joined to the frame or drag bar at one end, the other end joined to the front of the inside shoe. One end of the rod is threaded and one nut may be backed off. The nut on the other side of the fastening then may be run up to align the bar by rotating the shoe about the drag-bar connection. When proper alignment is secured these nuts should be tightened securely, that they may not work loose. One manufacturer uses an adjustment surrounding the rear hinge pin of the inside shoe. Each particular machine should be examined to see what provision is made and then adjustment may be made to align the bar and secure lighter draft.

Alignment of guards.—With the knife bar removed, guards which are badly out of alignment may be detected by sighting along the bar. The better way is to use a straight piece of strap iron or steel straight-edge 15 to 20 inches long and move it along on top of the ledger plates, noting which are high and which low. Drive guard out of alignment back into place by a sharp blow of the hammer at a point where the stock is thick. In replacing a broken guard by a new one the ledger plate may be too high. This can be remedied by putting tin shims between the guard and the bar when bolting on.

Dull ledger plates may be sharpened by removing the guard and grinding them on a stone, care being observed to preserve the original angle of shear. Broken ledger plates may be replaced and brought into line by shims, as for a new guard.

On stony ground the guard wing, the part which projects from the ledger plate, may become bent up, down, or sidewise. The function of this wing is merely to guide the cut grass out of the way of the knives. When bent they should be straightened to conform as nearly as possible to the new guard. Never bend down these wings to hold the knife against the ledger plates. If the points of the guards have become battered or blunted by use they may be taken off and ground to their original taper.

Adjustment of cutter-bar clips.—Examine the knife bar for kinks and bends and if present remove by straightening on a flat iron surface and put in the

least worn knife bar, care being observed that sections are in alignment on the bar. If the cutter bar is provided with wearing plates, adjust these plates to take up the back and forward play. The knife bar should move freely by hand, yet have little play. Starting with the clip nearest the inside shoe, tap with light blows of a hammer so that the clip just barely begins to tighten on the bar. Loosen the clip and proceed with the other clips in the same manner. When all have been set, tighten down securely. The knife bar then should move freely by hand. Some machines are provided with adjustable wearing plates in the knife head. If so, this adjustment should be made when the cutter-bar wearing plates are adjusted. If no provision is made, or if too badly worn, the knife heads and wearing plates should be renewed, as excessive wear at this point frequently is the source of broken knife bars.

Outside shoe.—The grass end of cutter bars on many machines is supported by a shoe resting on the ground. This is adjustable for height and should be attached rigidly. When badly worn it should be renewed. If, as in the case of some machines, the grass wheel is present, this should be examined. This wheel has a slight lead away from the grass. If the bearings are worn so that it leads into the grass, they should be renewed. The swath boards or swathing sticks have a useful function to perform. The connection at the point of the attachment should move easily but not too freely. Broken swath sticks should be replaced at the proper angle.

Grinding knife section.—Every machine should be equipped with two knife bars and the extra one taken to the field, so that when one becomes damaged or dull it may be replaced by one in good cutting condition. In grinding knife sections try to preserve the same cutting angle and bevel as that found on the new sections. Most operators grind away too much of the point and too little of the heel of the section. Thus a condition is brought about similar to that of trying to cut a hardwood toothpick with a wide open pair of shears. The toothpick merely slides along the shear blade until the proper angle of shear is reached. If by use a section becomes very much shorter than adjacent sections, it should be replaced by a new one.

To remove sections, do not punch out the rivets, thus enlarging the rivet holes and weakening the bar, but place the vertical edge of the bar on a solid piece of iron having a square straight corner and long enough to reach the sections adjacent to the one which is to be removed. Strike a smart blow with a hammer on the back of the section at a point directly above the rivet. This shears the rivet neatly, and only the punch is necessary for removing the sheared rivet from the bar. In replacing sections a soft steel rivet of proper size and length should be used, so that the hole is filled entirely and a neat button head may be produced. Never use rivets that are too hard or attempt to improvise rivets from nails or old screws.

Centering of sections.—When sections are centered properly with a pitman on either dead center, the center point of the section should center with the center line of the guards. If the sections do not center, it may be remedied by lengthening or shortening the pitman rod or lengthening or shortening drag bar, if this adjustment is provided. Other centering devices may be present on different machines, and the operator should examine the particular machine to see what provision exists, and make adjustments accordingly.

Pitman rod and knife-head bearing.—This usually is a ball and socket bearing. If by lack of attention the sockets have become elongated or the balls worn elliptical so that the lost motion can not be taken up, the only remedy is to renew either or both the knife-head and pitman-rod bearing. The bearing

should be adjusted so that there is no lost motion and be kept in this condition. When run for a considerable length of time in the same position of the tilting-lever notch a shoulder may be worn on the ball of the knife head. When shifted to another notch the bearing may bind at this point. About the only remedy is to adjust the socket bearing for the new tilting position. If this is not done, a broken piston rod may result, as well as a hot bearing.

Swivel joint and pitman wrist-pin bearing.—Play or lost motion at this point should be taken up if provision is made for adjustment. If none is made, these bearings, as well as wrist pins, if worn, should be renewed. If the front end of the crank shaft has much shake while being rotated, a new bearing for this shaft in the main frame should be supplied.

Main and countershaft gears.—On many machines provision is made for adjusting the mesh of the gears on the countershaft and main gears when worn. On some machines this is done by an adjustment which forces the countershaft in the proper direction to mesh properly. On others the main gear or countershaft gear itself is shifted by an adjustable collar or by placing washers behind the gear. If washers or gears are worn very badly, it may be necessary to replace either or both. See that the gear-control mechanism works smoothly and effectively. If any parts are badly worn, they should be renewed.

Drive wheels and pawls.—If there is excessive end play on the drive-wheel bearings, this should be taken up by adjustable collars usually provided on the main axle. Not to do so may result in broken pawls and pawl springs. Any accumulation of dirt or vegetable matter in the pawl boxes should be removed, and if the engaging faces of the pawls are worn unevenly it may be remedied by dressing the faces with a file.

General.—In general, tilting, hand, and foot lever connections, seat fastenings, and draft connections should be gone over to see that all fastenings are tight, lock nuts and cotter keys in place, and parts weakened by wear replaced. Special attention, especially in hilly regions, should be paid to draft and neck-yoke connections. On some machines the neck yoke is fastened to the tongue by eyebolts and riveted in place by washers. Through wear and exposure to elements these connections may be worn so much that while normally appearing safe they may give way at an inopportune moment and a serious accident to horses or operator result. An efficient operator of any machine acquires the habit of inspecting it frequently to discover loosened parts, lack of lubrication, hot bearings, etc.

Lubrication.—Inclosed gears run better when clean and lubricated with a stiff grease and graphite mixture. When not inclosed, lubrication may be detrimental, as it provides lodgment for grit and dirt. They should not, however, be allowed to become clogged with macerated vegetable matter and dirt. This applies to ratchet bearings as well.

Oil cups should be kept clean and care observed that the holes to the bearing are not caked with worn-out oil or dirt. At the beginning of the season's work it is desirable to remove from the bearings accumulations of caked and worn-out grease. This may be facilitated by flooding them with a few drops of kerosene oil. A wad of wool makes an excellent filter for filling the oil cups. Unlike cotton waste, it is not easily drawn into the bearings, is not subject to chemical action of lubricating oil, and does not become felted by use. A few drops of oil on the bearing surface of the knife bar when starting work with a new machine, or an old one when it has been overhauled, assist greatly in obtaining smoothness at these points. An efficient operator lubricates little and often those parts where the supply of lubrication can not be maintained by

means of oil cups. In dry seasons when the knife bar gums badly a squirt can filled with water, which may be applied occasionally, will cut away the gummed accumulation more effectively than oil.

Painting.—Wooden parts last longer and do not give way at unexpected moments if the protective coating of paint is renewed occasionally. Moreover, the second-hand value of the machine is enhanced thereby. The best treatment for the wooden pitman is an occasional application of warm, raw linseed oil.

REPAIR OF REAPERS.

Fundamentally, a reaper is only a mower equipped with a table or platform, which is a segment of a circle in outline, for collecting limited quantities of the cut grain, and with a rake head whereby the accumulations known as gavels may be removed, either automatically or at the will of the operator. Therefore, what has been said regarding mowers applies as well to reapers. In addition, the following suggestions are made:

Rake head.—Braces to the rake head from the platform, if pin-connected, become slotted in the pinholes by wear. Also, the bolts through the rake-head standard and frame casting may have become loosened and worn. This condition allows the rake head to sway and to rotate in a jerky manner and subjects the driving mechanism to undue strains. It may be corrected by removing the worn pins and bolts and having new heads forged on the braces with holes to size, or by replacing the braces with new ones. Bolts through the frame casting should be renewed if worn, and drawn up tight.

Many makes of reapers have shear pins intended to break when extraordinary stresses are put upon the rakes by lodged grain, etc. If these are worn, they should be renewed. They are of nominal size and can be replaced by cutting pins of required length from bar stock, riveting over the ends to hold them in place.

The cam-track latches should work freely and close promptly. If the closing spring is weak, this should be renewed. Quite frequently, when the reaper is being used to cut forage crops, buckwheat, and other grains of a succulent nature, the cam tracks become coated with macerated vegetable matter. This should be removed by scraping with a dull knife or a flat piece of metal. In no case should the cam tracks be greased if there is a rolling cam follower on the rakes themselves. Greasing will cause the rollers to slip and become flattened. If by careless application of lubricant some of the oil should work down on the cam tracks, it should be wiped off and the tracks dusted lightly with grit. If the follower is a shoe, the cam tracks should be lubricated with heavy oil or grease.

Rakes.—Rakes should be adjusted so that both ends bear equally on the table and only enough to sweep the table clean when discharging the gavel. The middle guard is provided with an extension, the purpose of which is to prevent the rake teeth from being drawn into the knives by lodged grain. Under ordinary conditions the rake should clear this guard easily. Broken rake teeth should be replaced. A few extra ones should be kept on hand. Their cost is trivial in comparison with the time expended in improvising teeth from whatever material may be at hand. If, on replacing, the new tooth is longer than those adjacent, it should be trimmed to equal length so that a neat gavel may be discharged.

Timing of rakes.—Adjustment of time of rise of rakes can be made further rearward in some makes of machines by taking out the filler washers between the rake cam and rake standard, and further forward by putting in additional washers. Other makes may have some other device, or no adjustment may be present. The particular machine should be examined to see what adjustment is present and this adjustment made accordingly.

Inside divider.—This usually is provided with an adjustment whereby lodged grain or grain leaning toward the stubble may be guided into the rakes by moving the divider toward the standing grain. If broken or bent from contact with obstructions, it should be replaced or straightened.

Outside divider.—This usually is wood and provided with a projecting guard or nose piece. It should be attached rigidly, and if battered or blunted may be removed and restored to its original shape by grinding. Flexible strips of wood or metal often are provided for guiding the standing grain into the knives, and, if broken or bent, should be replaced or restored to their original shape. Any projections that obstruct the passage of the outside divider through the standing grain cause it to be pulled down, and slovenly gavels result.

Grain wheel.—This wheel should run parallel to the line of draft or be given a slight lead toward the stubble, never toward the uncut grain. Probably no part of the reaper is neglected as much as this and is so large a source of side draft. It should receive frequent attention as to lubrication, and when worn the bearings, and even the wheel itself, renewed. As the part to which the wheel bearing is attached is adjustable for height, care should be observed that the guides are attached rigidly and that there is as little play as possible. The fenders, if broken or bent, should be replaced or restored to their original shape.

Rake-head driving mechanism.—On some makes of reapers, this is done by gears from the countershaft, on others by sprocket and chains. Adjustment for wear of gears may or may not be present. An inspection will determine. For machines equipped with sprocket-chain drive a chain tightener is provided. Where the chain has been increased in length by wear, remove a link if possible, rather than attempt to take up the slack by extreme adjustment of the tightener itself. When replacing the sprocket chain see that the openings of the hooks are on the outside and that hook ends of the links lead in the direction of the travel of the chain. The chain itself should be lubricated with graphite or a heavy grease and graphite compound.

General.—In general, examine the tilting lever connections, gear shift control, trip lever connections, and raising and lowering devices. These should work easily, yet the lost motion should be taken up as much as possible. The fastenings should be rigid. Seat fastenings and draft connections should be examined to see that all are tight and that the lock nuts and cotter keys are in place.

Storage.—The table may be folded for road transport and storage. This is done very quickly and easily. The machine, when folded, takes up very much less space and the platform does not become distorted by being unsupported. When not in use and when not folded, the rear end of the platform should be supported by a short prop. The weight on the tongue also should be supported by sufficient blocking under it at the draft connection.

The remarks on mowers relating to lubrication and painting apply to reapers as well. The machine should be run in gear for a short distance before cutting operations are begun. This helps to loosen it up and better work will be accomplished at the start.

REPAIR OF BINDERS.

The binder is a more complicated piece of apparatus than either the mower or reaper. Yet by a little systematic study of the various parts and their relation to each other, an intelligent mastery of this machine is acquired readily. It carries the preparation of the unthrashed grain for transportation and storage one step farther than the reaper, in that it binds and bunches the gavels so they may be shocked readily.

The cutting mechanism is similar to that of the mower, and so far as this is concerned, the remarks under the head of mowers apply to binders as well. Unlike the reaper, which collects the gavels intermittently on a stationary platform, the binder is equipped with a moving canvas or belt which conducts the cut grain to elevating canvases, which in turn carry the grain to the binder deck, where it is packed into a bundle of required size and the bundle wrapped and tied with twine. Some binders have been built and operated successfully whereby the platform canvas carries the cut grain direct to the binding deck without elevating the grain over the drive wheel. This type of machine is, however, in the minority. Differing also from the reaper, the rake-head is replaced by a reel which has a wide latitude of adjustment in order to pick up grain leaning away from the machine and to operate properly in very long or very short grain. To put the machine in good working order and adjustment the following points should be covered:

Platform and elevating canvases.—Before replacing canvas, see that rollers work easily, that they are straight and in good repair, and that they are in proper alignment. If not properly aligned the canvas will not run straight. To determine if the canvases are squared properly a new machine may be tested with a carpenter's square. The frame of an old machine, however, may be sprung, and a better way is to test the lengths of the diagonals. If the diagonals are not equal they may be brought to equal length by shortening or lengthening the brace rods provided for that purpose. Canvases not squared properly run hard, slats are broken, and excessive wear on bearings results. The canvases should be run only tight enough to prevent slippage, and when the machine is not in use or left over night, they should be slacked off either by loosening the buckles on the canvas straps, or by slacking off canvas tighteners. In replacing canvas see that the buckles lead in the direction of travel. Examine the roller bearings and if worn, replace.

Split or checked rollers, but straight otherwise, may be repaired by forcing the split or checked portions together in a vise, drilling them and countersinking for small bolts. The countersunk heads and nuts should clear the canvas, and the rollers should be protected from crushing in the vise jaws by wrapping with paper or old sacking. After repair the rollers may be smoothed off with a file or sandpaper.

All broken slats and straps should be replaced by new ones. Examine the canvas stretchers to see that they are working properly.

Canvas driving chains.—Clean thoroughly by scrubbing with an old discarded horse brush or scrubbing brush after soaking for a short time in a bucket of

coal oil or gasoline. Then rinse with clean coal oil or gasoline. In replacing chains see that the hooks are on the outside and that they lead in the direction of travel. Examine the sprocket gear bearings, clean out oil holes, and if bearings are badly worn, renew. See that the sprocket wheels are in line. This can be tested by sighting across the faces of the wheels. If there is excessive end play, take it up by placing washers back of the sprocket wheels. See that the chain tightener is adjusted properly; not too tight, but tight enough to prevent slapping of the chain. If the chain has increased in length from wear, remove a link, if possible, rather than adjust the tightener to an extreme position. The outside and not the inside of the chain should run over this wheel.

Outside divider and grain wheel.—See remarks under reaper, which apply to binder as well.

Reel.—See that the reel slats are in good repair and replace any that are broken or badly sprung. Connections to the arms and arm connections to the hub should be tight. The reels on most binders are placed so that the stubble end is given a lead ahead of the grain end. This is to counteract the tendency of the grain to elevate head end first. This tendency may also be overcome by attaching a thin strip of metal to the outside end of the platform, so that it lies on top of the canvas where the heads fall upon it. This retards the heads somewhat. A strap or rope also may be used for this purpose. To adjust the reel slats lower the reel and place the slats so that they clear the inside divider easily and run parallel to the platform canvases. To accomplish this it may be necessary to shorten the reel-post guide rod. In use, the skillful operator shifts the position of the reel to meet the varying conditions of the grain. It should be placed to strike the grain near the top and just far enough ahead to drop the grain onto the platform clear of the cutter bar. For lodged grain or grain leaning away from the cutter bar it will be necessary to place the reel further forward and lower, in order to pick up the grain and lay it over on the platform.

Examine the reel shaft bearings and if badly worn, renew. Some makes of machines employ a gear drive for the reel—others a sprocket and chain. If gear drive is used and is worn, examine for adjustment of gears for proper mesh and make the adjustment accordingly. In bevel gear drives, always secure the proper mesh by adjusting both gears equally. If renewals are necessary, renew both gears, as two worn gears or two new gears run with less friction than one worn and one new. If sprocket and chain drive are present, the same procedure may be followed as for canvas drive chains.

Examine the reel shifting lever connections to see that all latches work freely and positively. Take up lost motion wherever possible. Renew broken or excessively worn parts and see that all connections are rigid and tight.

Crown wheel.—Most makes of binders are driven by sprocket chain drive from a large sprocket, known as the crown wheel. This wheel is attached rigidly to the hub of the main, master, or bull, wheel, as the large drive wheel which carries the major portion of weight of binder, and which rolls on the ground, is variously termed. The crown wheel, by means of a heavy sprocket chain, drives the short shaft, known as the main shaft, which in turn drives the countershaft through bevel gears. The sprocket for driving platform and elevator canvases, packer, and binder shafts, and reel-driving mechanism is attached to the rear end of the countershaft. The crank or crank wheel and pitman are attached to the forward end. The clutch for throwing the machine in and out of gear usually is found on the main shaft.

The crown wheel should line properly with the sprocket wheel on the main shaft. This can be tested by sighting, or, better still, by placing the straightedge across the faces of the crown wheel and main-shaft sprocket wheel, care being observed that the crown wheel is not sprung and that it is bolted tight to the hub of the main wheel. If the main-shaft sprocket wheel is not in its proper position, it may be shifted into line.

The main chain should be removed, washed with gasoline or coal oil, and scrubbed free from all accumulations of dirt. When replacing see that it runs in the proper direction, hooks or flat side on the outside, and leading in the direction of travel. As the main wheel carries up a great deal of soil when rotating, it is not advisable to lubricate this chain with oil or grease. Dry flake graphite may be used, however. See that the tightener is in good repair and renew the tightener wheel and bearing if badly worn. This should be adjusted properly to take up the slack in the chain, but not too tight. Here, as in all chain drives, it is better to remove a link and shorten the chain rather than adjust the tightener to an extreme position.

Main wheel.—See that the main wheel is in the proper notch on the quadrant and square with the frame. When the binder is carried on transport trucks, the main wheel sometimes jumps out a tooth and does not run square with the frame when the binder is lowered into position for cutting operations.

Raising and lowering devices.—See that these work freely and that all fastenings are tight. If any parts are badly worn, renew.

Main shaft bearings.—If badly worn, renew. Flush occasionally with kerosene oil to remove worn out lubricants and other accumulations. See that they are being lubricated properly.

Countershaft and bevel gear drive.—Examine the bevel gears for the proper mesh, and if badly worn replace both gears with new ones. Improper meshing may be corrected by moving the bevel gear on the main shaft and also the bevel gear on the countershaft. Never make all of this adjustment on one gear in bevel gear drives but adjust equal amounts on each gear. Usually this may be done easily by means of a threaded end bearing on the countershaft and main shaft boxes. The particular machine should be examined to see what provision is made. Examine the countershaft bearings and if badly worn, renew. These also should be examined for proper lubrication, and flushed occasionally with kerosene.

Packer shaft, needle pitman, discharge arm shaft, etc.—These as well as binder attachments should be gone over in detail to see that all accumulations of vegetable matter are removed, oil holes free, and various parts work freely. Broken parts should be replaced and bent parts restored to their original form or replaced. Provision for taking up wear may or may not be made. Adjustments for proper operation usually are made to better advantage in the field. As such, they will be treated under another heading, "Bundles and tying troubles and their remedy."

General.—In general the tilting lever and connections, binder shifting levers, bundle carrier trip, butt adjuster lever, and reel shifting lever should be examined to see that they work freely and positively, that those parts showing excessive wear are renewed and all fastenings are tight. The main frame should be gone over to see that all connections are tight. Broken or bent frame braces should be renewed or straightened. Draft and seat connections should be examined to see that all are tight and that all lock nuts and cotter keys are in place.

During the harvest when it may not be convenient to put the binder under cover at the end of a day's work, the binding deck, elevator, and platform canvases should be protected from rain and dew with a tarpaulin, securely fastened down so that gusts of wind will not expose these parts to the elements.

Storage.—At the end of the season when preparing for storage, here, as well as with other farm machines, a list of the needed repairs and note of the season's difficulties with that machine should be made and filed in anticipation of the future, when repairs may be made more conveniently. A hazy recollection of the past season's difficulties and tardy receipt of repair parts will be obviated thereby, and the prosecution of the work will be facilitated. Trucks are provided for road and storage transport.

Some systematic plan should be adopted to prepare the machine for storage. Remove the canvases, wrap up carefully, and store in a dry place away from mice or rats, or hang them over a round stick with ends free and even and in a dry place. Thus mice and rats can find no place for nests.

Apply a good leather dressing, harness oil, or tallow to leather straps to prevent them from becoming dry and hard and cracking in use. Never apply a mineral oil to leather. The knife bar and wooden pitman should be removed and stored in a dry place. The knife bars should be cleaned and greased. The pitman should be stored on a shelf or flat place, so that it will not spring or warp. Grease the ledger plates, knoter, and twine holder, needle point, twine eyes, and all bright parts of the machine and binding mechanism in general. The chains also may be removed, cleaned (preferably in a bath of coal oil), wiped dry, and oiled. They should be labeled, tied in a bundle, and hung in a dry place. Some of the reel arms, as well as the tongue, may be removed if storage space is at a premium. If any wooden parts are removed, they should be stored in a dry place and in such a manner that they will not warp. In preparing a machine for storage, store all attachments in one place and all bolts and washers should be replaced in the part from which they were removed. If the tongue is not removed it should be supported by blocking at the draft connection so that it will not acquire a permanent set. The bearings throughout the machine should be oiled with a heavy oil which will not run out readily.

Painting.—As with mowers and reapers, wooden parts do not warp or decay as rapidly, and the second-hand value of the machine is enhanced if the protective coating of paint is renewed at the proper time. The reel slats and arms, outside dividers, tongue, neck yoke, whiffletrees, deck, guides, etc., come within this class. An application of warm, raw linseed oil will be better for the wooden pitman and canvas rollers.

Lubrication.—An efficient operator lubricates little and often those parts where a sufficient supply can not be maintained. No other farm machine demands so much attention in this respect as the binder. The operator should familiarize himself with the location of all oil holes and cups and prosecute this duty in a systematic manner so that no bearings are neglected. He should not squirt oil at random, trusting to chance that some of it will reach the bearing, but should see that all oil holes are clear, and apply only enough to effect the desired purpose. If by careless application oil is smeared over adjacent parts, the excess should be removed with a rag so as not to afford lodgment for grit, which may subsequently work its way into the bearing. When lubricating, watch out for loose bolts, parts out of adjustment, etc. An efficient operator readily detects any discordant note in the customary hum of the machine and remedies the trouble at once. A loose bolt or knock may cause the breakage of a

part which, inexpensive in itself, may cause several days of expensive delay in the rush of the harvest season.

Oil cups should be packed with a filter of wool. This is more satisfactory than cotton. A few drops of oil on the bearing surfaces of the knife bar when starting work with a new machine or an old one that has been overhauled assist greatly in obtaining a smooth bearing at these points. Before starting cutting operations it is a good plan to run the machine in gear for a short distance if possible. This helps to loosen up the machine in general and better work will be accomplished at the start.

Bundle and tying troubles and their remedy.—The grain covers on the binding deck of most machines are made adjustable so that they may be raised for heavy grain or lowered for light and loose grain, in order to force it down against the packers. To bind at the middle of the bundle, shift the binding attachment rather than the butter, except for very short grain. The butter should be at right angles to the rollers; if it does not work in this position a bundle with a slanting instead of a square butt will be formed. Usually a header board is provided also, which may be removed when cutting very long grain.

The twine tension should be kept just tight enough to take the slack out of the twine. If the twine tension is too tight, a groove will be worn in the needle eye, twine disc, and other parts through which the twine is threaded, and tying troubles will result. Never attempt to regulate the size of bundles by adjusting the twine tension. If larger and tighter bundles are desired for ripe and dry grain, increase the tension on the trip spring, thus moving the compressor arm back. For those binders which have a separate trip and compressor arm, the trip spring should be tightened when the compressor arm is moved back. If smaller and looser bundles are desired for wet or green grain, this procedure should be reversed—i. e., the tension on the trip spring should be decreased, and if necessary to move compressor arm forward the trip spring should be loosened. Sometimes in heavy tangled grain difficulty is encountered in discharging bundles, and “choking” of the machine results. The remedy is to adjust the trip and compressor arm for tying a smaller and looser bundle, or by raising the grain cover of the binder deck slightly in order to give more clearance.

A binder will do its best work if tilting slightly into the grain. If unbound bundles are thrown out at the start of cutting operations of a new binder or one which has been overhauled do not attempt to make adjustment, but proceed for a short distance until the operator is satisfied that the trouble lies in the knotter and is not due to paint or rust, which will soon wear off.

The binder attachment proper is a somewhat complex piece of mechanism, yet with a little study of the particular machine in hand it is mastered easily. In replacing broken, worn, or bent parts of the binder attachment, bear in mind that all moving parts must work at the proper time and in unison with other parts. With this in mind, before removing any parts, examine the attachment for any timing marks which have been placed thereon by the manufacturer. These usually are projections cast on a pair of opposite cogs in gears meshing together, or may be some symbol stamped into the metal itself. If no marks can be found, difficulty in assembling may be obviated by making time marks with a small, sharp cold chisel. A good mechanic in taking down any piece of machinery does so in a systematic manner, with due regard to the relation of the parts, so that in assembling bolts and attachments are put back into the original position. If such care is observed, the original bearings are preserved and parts do not become loosened as readily by use.

If, after proceeding a short distance, the machine continues to discharge bundles without binding them, examine the twine knife. Like any edged tool this becomes dulled by use and should be sharpened occasionally. A small whet-

stone or a small mill file should be used for this purpose. Try to maintain the original bevel of the knife, with a clean, sharp cutting edge. Never use a file on the knotter itself. The trouble possibly lies somewhere else, and a systematic inspection of the bands usually will determine its location. All knotter-

FOUND ON KNOTTER HOOK OR BILLS.



FIG. 1

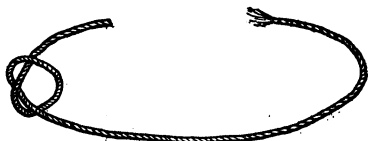


FIG. 2

FOUND WITH BUNDLE.

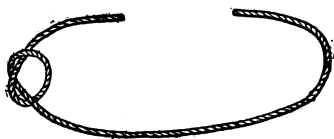


FIG. 3

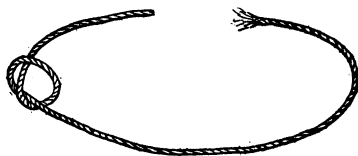


FIG. 4

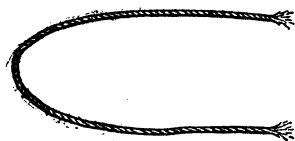


FIG. 5

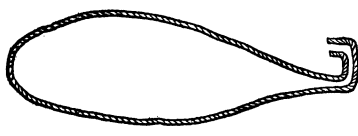


FIG. 6

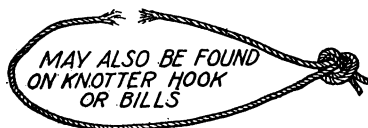


FIG. 7

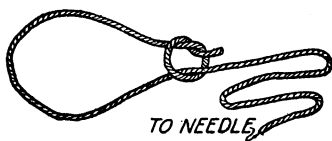


FIG. 8

Examples of defective binder ties.

head adjustments should be made gradually. If too great changes are made, the proper set of the parts will be missed and other troubles will result.

If the band (fig. 1) is found clinging to the knotter hook or bills with the free end cut off square, it indicates that the twine disc is too loose or the

twine tension too tight. The remedy is to loosen the tension, and if this does not correct the trouble tighten the disc spring slightly.

If the band (fig. 2) is found on the knotter hook or bills with loose end ragged or crushed, loosen the twine tension, and if this does not remedy the trouble loosen the disc spring slightly.

If the band (fig. 3) is found with the bundle with a single knot in one end, but the free end cut off square, tighten the disc spring, and if this does not overcome the difficulty examine the disc for wear. If badly worn the only remedy is to replace the disc with a new one. If this occurs regularly with each fifth, sixth, or seventh bundle, look for wear in one notch of the disc. A very loose or broken twine tension may be the cause of the twine not being stretched tightly across the knotter hooks or bills.

If the band (fig. 4) is found with the bundle with a single knot in one end and the free end ragged or crushed, the twine tension is correct, but the disc spring is too tight. The remedy is to loosen the disc spring.

If the band (fig. 5) is found with the bundle, but both ends free from knots and straight, and each end ragged and crushed, the tension is right, but the disc spring is very tight. The remedy is to loosen the disc spring.

If the band (fig. 6) is found with the bundle, but both ends free from knots, and folded, showing that the knot was formed but not completed, examine the knotter hook or bills. The knotter hook or bill spring may be too loose or the hook or bills worn so badly that the ends were not held sufficiently tight to form a knot. The remedy is to tighten the knotter hook or bill spring, or, if excessive wear is present, replace the knotter hook or bills and shaft complete.

If the band (fig. 7) is found with the bundle, or clinging to knotter hook or bills in some cases with the knot perfectly formed but the band broken, the trouble may result from the knotter hook or bill spring being too tight when tying loose bundles. The remedy is to loosen this spring slightly, or set the trip and compressor arm to bind larger and tighter bundles. It may be caused also from a worn cam roller on the stripper arm. The remedy is to supply a new stripper arm complete.

If the bundle is tied with a slip noose (fig. 8) with the twine extending from the discharged bundle to the needle eye, the needle has failed to place the twine in the disc holder, because of excessive wear in the needle eye itself. If the needle eye does not have a special wearing piece, the only remedy is to supply a new needle. In replacing the needle the point should protrude slightly above the deck when the needle is at rest.

As applying to some makes of machines, sometimes the bundle is tied properly but with a bowknot in one end. This knot simply includes the short piece of twine which other makes of machines cut loose and which is lost by the machines that tie a hard knot. This knot withstands rough handling as well as a hard knot, and is not an apparent waste of twine. Knotters properly adjusted will not handle twine that is not reasonably uniform. The remedy is obvious.

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